Ceramic Resonator Application Notes

CERAMIC RESONATORS APPLICATION NOTES

GENERAL DESCRIPTION

Why ceramic resonators? Ceramic resonators stand between quartz crystal oscillators and LC/RC oscillators in regard to accuracy. They are considerably smaller, require no adjustments, with improved start-up time and low in cost.

Package: Ceramic resonators come with standard, single-in-line package (LXZT and HXZT), or 3-leads with built-in capacitors (ACR).

Properties: The oscillation of ceramic resonators is dependent upon mechanical resonance associated with their piezoelectric crystal structure. These materials (usually barium titanate or lead-zirconium titanate) have large dipole movement which causes the distortion or growth of the crystal by an applied electric field.

Frequency Range: The available frequency range varies from 190 kHz to 16 MHz.

Frequency Stability: The maximum allowable frequency deviation compared to the measured frequency at 25º C over the temperature window, i.e., -20ºC to +80ºC. The typical stability is ± 0.3% (±3000ppm).

Frequency Tolerance*:* The allowable deviation from the nominal frequency at room temperature. Frequency tolerance is expressed in percentage, typical ±0.5% or in parts per millions (ppm), ±5000ppm.

Resonant Impedance: The value of impedance the crystal exhibits in the operating resonant circuit.

Aging: The relative frequency change over a certain period of time. This rate of change of frequency is normally exponential in character. Typically, aging is ±0.5% over 10 years.

Frequency Stability: The maximum allowable frequency deviation compared to the measured frequency at 250 over the temperature window, i.e., -20ºC to +80°C.

Load Capacitance: Load capacitance (C_L) is the amount of capacitance that the oscillator exhibits when looking into the circuit through the two resonator terminals. Load capacitance is expressed in a pair of C_l and C_2 with the default values given in table.

Equivalent Circuit: Its equivalent circuit is similar to the quartz crystal equivalent circuit, i.e., consists of a series L_l, C_l, R_l circuit shunting with a parallel C_O capacitance. A standard HXZT-4.0000MHz has its typical parameters as follows: L - 330uH, C_l - 5pF, C_0 - 40pF, and Q ~ 900.

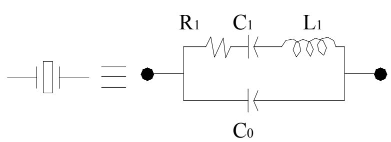

Figure 1

TEST CIRCUITS FOR CERAMIC RESONATORS

Ceramic resonators: *with built-in capacitors:* It consists of a CMOS inverter with a feedback resistor Rf (figure 2). The feedback resistor allows oscillation to start when power is initially applied. Its value is generally 1 MΩ. The values of C_l and C_2 is given in the table or specified by customer.

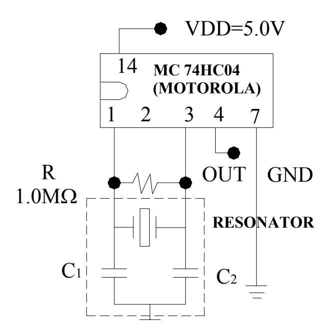

Fig. 2 Test circuit

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APPLICATIONS

Ceramic resonators are used mainly as a source of clock signals for many microprocessors, which tight frequency stability is not a primary concern. Ceramic resonators are low in cost and are built-in with capacitance for space savings. Ceramic resonators are mainly used in consumer electronics applications (TV, VCR, games, radios) and household appliances. Fig. 3 shows a typical curve of impedance vs. phase of a 4 MHz ceramic resonator.

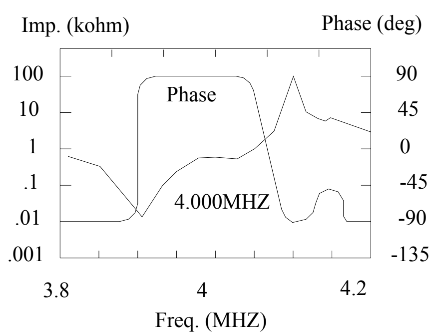

Fig. 3 Impedance vs. phase of a 4.000 MHz ceramic resonator.

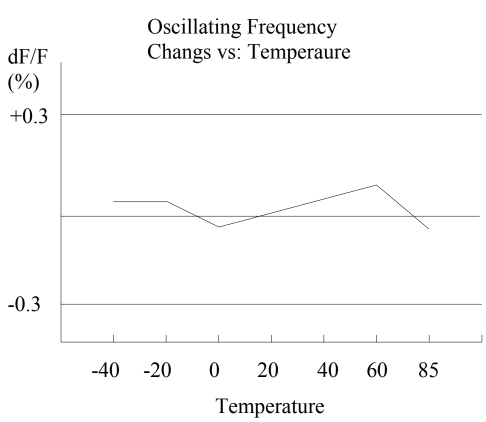

Fig. 4 Typical curve of frequency vs. temperature

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